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PUBLIC-PRIVATE PARTNERSHIPS IN AGRICULTURAL RESEARCH: AN ANALYSIS OF CHALLENGES FACING INDUSTRY AND THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

David J. Spielman and Klaus von Grebmer

Environment and Production Technology Division

International Food Policy Research Institute
2033 K Street, N.W.
Washington, D.C. 20006 U.S.A.

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ABSTRACT

Public-private partnerships offer potentially important opportunities for pro-poor agricultural research in developing countries. Yet in the international agricultural research community—and with regard to the Consultative Group on International Agricultural Research (CGIAR) itself—we see few examples of successful public-private partnerships, and fewer examples where such collaborations have contributed to food security, poverty reduction and economic growth. This study assesses the opportunities for, and challenges to, creating and sustaining public-private partnerships between the international agricultural research centers of the CGIAR and leading multinational, research-based agribusiness companies.

The study hypothesizes that the willingness and ability of public agencies and private firms to enter into partnerships are constrained by fundamentally different incentive structures; by insufficient minimization of the costs and risks of collaboration; by an inability to overcome mutually negative perceptions; by limited use of creative organizational mechanisms that reduce competition over key assets and resources; and by insufficient access to information on successful partnership models. The study methodology is based on interviews and discussions with key stakeholders and a wide review of the literature on public-private partnership.

Tentative findings suggest that while incentives and perceptions do differ between sectors, sufficient common space exists or can be created through incentive structuring to facilitate greater partnership. However, both public- and private-sector partners inadequately account for and minimize the costs and risks of partnership. Similarly, partners discount the need for brokers and third-party actors to manage research collaborations and reduce competition between sectors. Finally, partners are operating without sufficient information on existing partnership experiences, lessons, and models, potentially contributing to a persistent or widening gap between sectors.

KEYWORDS: Public-private partnership, collaborative research, private sector, multinational firms, agricultural research and development, agricultural biotechnology, intellectual property rights

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David J. Spielman and Klaus von Grebmer[2]

1. INTRODUCTION

Empirical evidence strongly suggests that agricultural research can improve the lives of poor people in developing countries. Research contributes to the enhancement of agricultural productivity, output, and quality; to improvement in sustainable use of natural resources; to lower consumer prices for food; and to the accumulation of physical and human capital among poor or vulnerable agrarian agents and households. These improvements lead to higher incomes, greater food consumption, better nutrition, and favorable changes in the allocation of individual and household assets (Meinzen-Dick et al. 2003; Hazell and Haddad 2001). Such changes play an important role in improving the livelihoods of small-scale, resource-poor farmers, food-insecure urban and rural households, and other low-income individuals and households, and in stimulating economic growth and development.

Public-sector institutions account for approximately 94 percent of the $12.1 billion spent annually on agricultural research in developing countries during the mid-1990s (Table 1) (Pardey and Beintema 2001). Yet during this period, the growth rate of public expenditure on agricultural

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[2] David J. Spielman is a consultant on public-private partnerships to the International Food Policy Research Institute, Washington, D.C. Klaus von Grebmer is Director, Communications Division, International Food Policy Research Institute, Washington, D.C.

research slowed dramatically in many developing countries, even declining in sub-Saharan Africa. At about the same time, funding for the Consultative Group on International Agricultural Research (CGIAR)-supported research centers stagnated in real terms, shifted away from research in staple crop improvement, and became increasingly restricted (World Bank 2003). Beyond the leading national agricultural research systems (NARS) in the developing world such as those of China, India and Brazil, there is little evidence of change in these trends.

Against this trend, private-sector investment in agricultural research is increasing worldwide, accounting for approximately 35 percent of global investment in agricultural research and development (R&D), or $11.5 billion per annum during the mid-1990s (Pardey and Beintema 2001). Approximately 13 percent of this figure is invested in advanced research in agricultural biotechnology by the leading multinational firms and other, smaller biotechnology firms (Byerlee and Fischer 2001). However, these resources are rarely invested in research that is directly or intentionally pro-poor: the vast majority of private-sector investment in agricultural research is directed toward those crops, traits, and technologies that benefit farming in advanced, industrialized countries and are profitable enough to guarantee adequate returns on investment in research. The few resources diverted to developing countries (either directly or in the form of research spillovers) tend to be concentrated in large countries with highly commercialized agricultural sectors; therefore the effect of such research on small-scale, resource-poor farmers and other vulnerable agrarian agents is ambiguous.

Table 1--Public-and private-sector expenditure on agricultural research, c. 1995[a]

Region	Expenditure (1993 US$ PPP)[b]			Share of Total Expenditure (%)	
	Public	Private	Total	Public	Private
Developing	11,469	672	12,141	94.5	5.5
Industrialized	10,215	10,829	21,044	48.5	51.5
Total	21,692	11,511	33,204	65.3	34.7

Source: Pardey and Beintema 2001. [a] Estimated annual average for the period 1994-96. [b] Figures expressed as real expenditure, calculated by deflating nominal expenditures in local currency using a 1993 price deflator, and converting to U.S. dollars using purchasing power parity exchange rates for 1993. See source for details.

One way of ensuring that pro-poor research programs are maintained and strengthened in the face of waning public commitment is through research collaboration, partnership, or other forms of interaction between the public and private sectors. *Public-private partnerships,* as they are referred to throughout this study, are defined as any collaborative effort between the public and private sectors in which each sector contributes to the planning, resources, and activities needed to accomplish a mutual objective. A relatively new and diverse body of theoretical and empirical literature suggests that public-private partnerships are a constructive means of enhancing the production of goods, services and technologies that would not otherwise be produced by either sector acting alone.

When structured appropriately, public-private partnerships can generate significant benefits for private firms and public institutions while also serving the interests of resource-poor or vulnerable households in developing countries. Partnerships can offer private firms access to farmers in emerging markets; the chance to wield constructive influence in the development of legal and regulatory regimes; opportunities to participate in important local, regional, and global forums on pro-poor research; and prospects to improve corporate profiles and reputations. Partnerships can provide public agencies access to new, cutting-edge scientific expertise and knowledge and technologies held by the private sector; mechanisms for developing, marketing

and distributing final products; and financial resources that are otherwise increasingly difficult to obtain. Collectively, public-private partnerships improve the capacity of researchers to address problems in agriculture that cannot be solved by a single actor, cannot be achieved in a manner similar to the relatively rapid, easy gains of the Green Revolution, or require navigation through uncharted, country-specific research systems and regulatory environments.

There is ample evidence to suggest that public-private partnerships are increasingly popular in development policy and practice as a means of addressing global issues as diverse as health, environment, finance, governance, and agriculture (World Bank 2002; Buse and Walt 2000b). The international health sector, for example, hosts more than 100 public-private partnerships addressing 40 distinct diseases and conditions (IPPPH 2003). These partnerships bring together resources and expertise from a wide variety of actors, including international organizations, government agencies from developing and industrialized countries, multilateral and bilateral donors, philanthropic foundations and non-governmental organizations, and some of the largest pharmaceutical and medical research companies in the sector (Ollila 2003; UNF/WEF 2003; Buse and Walt 2000a).

Yet one finds few examples of pro-poor public-private partnerships in the international agricultural research community, and fewer still where the expected benefits of partnership have materialized. In the CGIAR itself, examples of successful and sustained cooperation are either uncommon or undocumented, despite a long-articulated expression of interest and support for greater intersectoral collaboration (Leisinger 1995; James 1996; CGIAR 1998). Consequently, opportunities are likely being lost for both hunger and poverty reduction and for facilitating growth and development in developing countries. Serious concerns and frustrations have been voiced within the CGIAR over these forgone opportunities.

The rarity of successful partnership examples does not necessarily reflect a lack of interest or commitment on the part of either the CGIAR or the private sector. The Third System Review of the CGIAR (1998) called for greater partnership with the private sector. A wide survey of CGIAR stakeholders conducted by the World Bank (2003) found significant support for increased public-private collaboration among CGIAR center director generals, donors, representatives of national agricultural research systems, and members of the private sector. Moreover, efforts have been made in several forums to promote public-private partnership in agricultural research. The CGIAR Private Sector Committee has attempted to address a range of issues in agricultural research by providing the system with private-sector perspectives and by facilitating new programmatic partnerships (PSC 1999, 2003). The Tlaxcala Statement of 1999, an initiative involving several multinational firms, international organizations and CGIAR centers, provided a road map toward greater private-sector cooperation and investment in pro-poor agricultural research. Roundtable meetings convened by the World Bank in 2000 and again in 2004 brought its leadership and the CGIAR together with executives of major agribusiness companies on issues of research complementarities and coordination. The United States Agency for International Development (USAID) and the Department for International Development (DfID) in the United Kingdom have been strong proponents and financiers of several public-private partnership initiatives. The Global Forum on Agricultural Research weighed in on the topic during its meetings in Dakar in 2003, as did the World Economic Forum in Davos (GFAR 2003; WEF 2003a,b,c). Experts from leading agricultural research firms have joined with academics and policy researchers to express their views on key topics such as pro-poor research collaborations, plant genetic resource management, and intellectual property rights (Leisinger

1995; Barry and Horsch 2000; Shear 2000; Richer and Simon 2000). In short, there is no lack of interest in public-private partnerships in agricultural research.

Yet despite the growing popularity of this approach, there are few systematic assessments of why real successes have been so limited. Rather than analyze the underlying causes of limited success, the literature on public-private partnership offers expert discussions of the benefits of partnership, simplistic how-to manuals for planning and implementation, broad policy guidelines and frameworks, and glossy write-ups of the few existing partnership successes. Thus, there is a need for a more critical and analytical study of why sustained and successful partnerships are so few in number, and why, as a result, opportunities for pro-poor research have been missed.

Table 2--R&D spending and sales of leading multinational firms, 2002

Subsidiary/Parent, ***Country of Headquarters***	**R&D Expenditure[a] (US$ million)**	**Sales[a] (US$ million)**	**R&D as a Percentage of Sales**
Syngenta, *Switzerland*	697	6,197	11.2
Monsanto, *U.S.*	527	4,936	10.7
BASF, *Germany*	349	4,678	7.5
Pioneer Hi-bred/Dupont, *U.S.*	506	4,510	11.2
Bayer CropScience/Bayer, *Germany*[a]	568	4,462	12.7
Dow AgroSciences/Dow, *U.S.*	na	2,717	≥ 10.0
Grupo Limagrain, *France*	70	965	7.3
Savia, *Mexico*	na	611	na
Advanta, *Netherlands*	59	398	14.8
Total	**2,776**	**29,474**	
Average[b]	**515**	**3,275**	**10.6**
CGIAR Total Expenditure	369	na	na

Sources: Corporate, CGIAR annual reports; pers. comm. [a] Includes only sales and R&D expenditure in the categories of crop and animal protection, seed and planting materials, food, and nutrition. [b] Averages for R&D expenditure and R&D expenditure as a percentage of sales are weighted by sales and adjusted for missing values.

Through this study, the International Food Policy Research Institute attempts to treat this matter as a policy research issue by assessing the opportunities for, and challenges to, creating

and sustaining partnerships between public research agencies and private firms. Specific emphasis is placed on the international agricultural research centers of the CGIAR and the leading multinational, research-based agribusiness companies (Table 2). Emphasis is also placed on research partnerships in the area of agricultural production technologies, although subsequent research will expand the scope to include collaborations on the value-added production, processing, storage, marketing, and distribution of agricultural products.

This study begins with the assumption that public-private partnerships are a beneficial approach to pro-poor agricultural research, an assumption that has been addressed by prior studies on the topic, discussed below. The study proceeds by examining five hypotheses that may explain the low willingness and ability of public institutions and private firms to enter into partnerships. They are as follows:

- Public and private partners are challenged by fundamentally different incentives.
- Public and private partners do not adequately account for and minimize the direct and hidden costs of a collaborative research investment.
- Public and private partners are hindered by persistent negative perceptions of each other.
- Public and private partners are constrained by the lack of creative organizational mechanisms to reduce intersectoral competition for key assets and resources.
- Public and private partners are impeded by the limited availability of information on successful working models of partnership.

Tentative findings suggest that while incentives and perceptions do differ between sectors, sufficient common space exists or can be created through incentive structuring to facilitate greater partnership. However, both public- and private-sector partners inadequately account for and minimize the costs and risks of partnership. Similarly, partners discount the need for brokers and third-party actors to manage research collaborations and reduce competition

between sectors. Finally, public- and private-sector partners are operating without sufficient information on existing partnership experiences, lessons, and models, potentially exacerbating the gap between sectors.

This study is structured as follows. Section 2 sets forth a conceptual framework, reviewing the literature on public-private partnerships and explaining the study methodology. Section 3 examines each of the hypotheses enumerated previously. Section 4 summarizes the findings and provides a brief set of policy recommendations.

2. A CONCEPTUAL FRAMEWORK

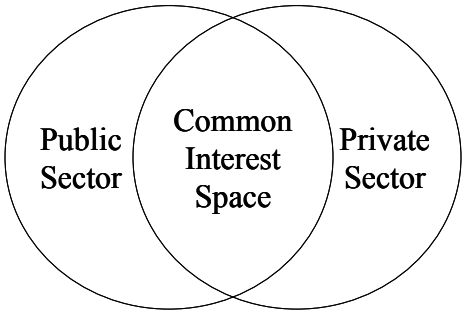
The term public-private partnership covers a wide variety of interactions including university-industry research projects, multi-party and multi-sectoral research consortia, local development programs between small businesses and government, or large-scale global partnership programs. Public-private partnership is defined here as a collaborative effort between the public and private sectors in which each sector contributes to the planning, resources, and activities needed to accomplish a shared objective. Such a partnership is initiated to pursue shared objectives, and depends on complementarities between partners, institutionalized structure and support, and the production of scientific knowledge and technology in a manner that generates research synergies. A public-private partnership is also defined by the nature of the parties engaged in the collaboration. In the strictest terms, a public-private partnership is, in the present context, an arrangement entered into between two or more parties, specifically a *non-profit, publicly-funded institution* (e.g., CGIAR centers and national agricultural research agencies), on the one hand, and a *for-profit company* (e.g., major multinational, research-based agribusiness firms), on the other.

THE THEORY OF PUBLIC-PRIVATE PARTNERSHIP

The literature on public-private partnership is both multidisciplinary and disparate. Within the standard neoclassical economics literature, public-private partnerships are the subject of traditional welfare analysis, typically evaluated according to the efficiency of their social welfare impact given scarce resources for research. Public-private partnerships are also a topic of analysis in information economics, where studies focus on the relationships and incentives that structure the flow of information between agents (Binenbaum et al. 2003). Further, public-private partnerships are a topic of increasing investigation in the industrial organization and public finance literature, as an alternative structuring of production processes and public support to research (Van der Meer 2002).

In the institutional economics literature, public-private partnerships are viewed as a governance strategy designed to minimize transactions costs, or the costs associated with forming and sustaining relationships—contracting, coordinating, and enforcing a relationship—between actors engaged in the production of some good or service (Williamson 1975, 1979). The magnitude of such transactions costs is determined by the frequency with which public and private entities interact, the uncertainty of these transactions and the limits on actors' rational behavior, and the specificity of assets used in the interactions (Rangan et al. 2003). To the extent that partnerships reduce transactions costs and improve the potential for realization of economic opportunity, they may be a more beneficial structure of production than, say, market-based operations, inter-firm research consortia, or vertical integration of production activities into a hierarchical firm structure.

Figure 1--The Common Interest Space



Source: Hartwich, Janssen, and Tola (2003, 6).

The innovations system literature focuses on the economic and social institutions that affect the opportunities for science-based innovation within a given social or geographic region (Dosi et al. 1988; Hartwich et al. 2003). This literature has contributed significantly to discussion of networks and their effect on the activities and interactions that generate innovation. Moreover, it extends discussion from the role of the Schumpeterian entrepreneur and firm to the wider importance of social institutions and their interactions with public and private research organizations. Central to this approach is the identification of a common interest space (Figure 1), within which activities follow from objectives shared by both partners (Hartwich et al. 2003). Several studies apply the approach to agricultural research partnerships in developing countries such as Argentina and India (Ekboir and Parellada 2002; Hall et al. 2002).

In the development policy and public administration literature, the study of public-private partnership represents a recent paradigm shift in organizational thinking. The literature argues that public-private partnerships are an optimal policy approach to promoting social and economic development that brings together the efficiency, flexibility, and competence of the private sector with the accountability, long-term perspective, and social interests of the public sector (Richter 2003; O'Looney 1992; Etzioni 1973). While such partnerships blur the classic distinction between the public and private sectors in a modern economy, they also enhance the potential for both efficient and equitable production and distribution of social benefits (Larkin, 1994). These issues receive particular attention in the health and pharmaceutical sectors, where global and

regional public-private partnerships are increasingly common (Buse and Walt 2000a,b; Buse and Waxman 2001; Lehman 2001; Ollila 2003).

This is not to say that public-private partnerships are without their detractors and critics. An emerging literature challenges the argument that public-private partnerships are unequivocally beneficial to society. The most significant criticisms emanate from the health sector and highlight issues that include conflicts of interest for institutions such as the World Health Organization (Richter 2001, 2003); the ethics of public-private partnership (Roberts et al. 2000); transparent and accountable governance of partnerships (Buse and Walt 2000a,b); and the appropriate roles for civil society, private firms, and public agencies (Buse and Waxman 2001). In the agricultural research sector, only a few studies raise similar or analogous issues, such as the preservation of the CGIAR's germplasm collection for exclusive use in the public interest despite attempts to claim patents over derivatives of CGIAR germplasm (see GRAIN 1998, 2003; Ho 2003a,b).

METHODS AND TOOLS OF ANALYSIS

Just as scholars study public-private partnerships from a wide range of perspectives, researchers use different methodologies to approach the topic. A particularly useful approach to the study of knowledge-intensive sectors such as agricultural research is the identification and description of the relations and networks through which information moves between and among agents. The meta-modeling of relationships approach used by Binenbaum et al. (2003), for instance, dissects the relations between organizations, the incentives that motivate their behavior, and the problems associated with those incentives. By reconstructing the relations and incentives under alternative scenarios, the analytical output, typically embedded in game theory, develops an enhanced perspective on the process by which information flows between organizations. Key

elements include analysis of players and their objectives, incentives, and relations; the structure and flow of information and the mechanisms that make information flows possible; the choice variables and sequence of moves among players; and the relation and incentive problems that impede players' moves and the flow of information. A similar, more straightforward approach to the study of public-private partnerships relies on the identification of dilemmas and tensions inherent in the content and process of partnership (De Bruijn and Van der Voort 2002).

The novelty and situational specificity of public-private partnerships, however, often necessitate a less intricate methodological approach that relies on descriptive or comparative analysis of agents and their mechanisms of interaction. Studies by Pray (2001), Pray et al. (2001), and Huang et al. (2002), among others, describe the evolution and emergence of new public-private collaborations and technology-transfer mechanisms in several developing countries, their impact on agricultural research, and their wider replicability and applicability to research in other countries. Similarly, Michelsen (2003) examines the partnership experiences of a single, public agricultural research institution as a means of extracting lessons for successful partnering.

Although these approaches contribute to the study of the dynamics and limits of public-private partnership, additional tools and methods are required to assess outcomes and impacts. A traditional performance measurement approach—a basic input-output analysis approach, augmented by process analysis (throughput analysis)—offers one means of evaluation (De Bruijn and Van der Voort 2002). A multidimensional approach that relies on indicators of the values and capacity of partners, their interaction mechanisms and processes, and their impacts on objectives, partners, and society provides yet another perspective (Charles and McNulty 1998, 1999). Of these methods, the most effective are arguably those that place specific emphasis on

quantitative and qualitative measures of cost and quality; equity and access; and regulation, accountability, and conflicts of interest among partners (Rosenau 1999).

Finally, the study of public-private partnership is informed by analysis of perceptions between partners. Understanding how actors perceive an organization, its capabilities, and its incentives is important to developing both short- and long-term strategies for public-private partnership. An audit of perceptions and opinions provides information about how key players in the public and private sectors view each other, even where they are not engaged in partnerships. Buurma and Boselie (2000) use perception analysis to identify the interests, potential for mutual benefits, and behavior of stakeholders in the development of an agricultural supply chain. Driscoll et al. (1979) use perception analysis to measure the magnitude of persistent negative stereotypes held by public- and private-sector managers of each other, even where strong similarities in individual responsibilities and characters exist. Sandman et al. (1993, 1998) uses perception analysis to examine risk assessment and communication of risk between agents.

STUDY METHODOLOGY AND DATA

This study draws on each of the methodologies described above, while taking an essentially qualitative approach to assessing the challenges to successful public-private partnerships in pro-poor agricultural research. Data were gathered from key stakeholders through: semi-structured interviews conducted in person or by telephone or email; open-ended discussions conducted in person; and formal presentations. A questionnaire was used to provide the basic frame of inquiry for the semi-structured interviews (Annex A), while informal discussions and presentations were structured by the subjects themselves.

Key stakeholders are identified as individuals with specific knowledge of or experience with public-private partnerships in agricultural research, and include: CGIAR center

management and research staff; key executives of private companies; members of the CGIAR Private Sector Committee and its recent External Review Panel; members of the international donor community; members of non-governmental organizations and philanthropic foundations; and policymakers from agricultural research agencies in developing countries. Of approximately 40 individuals that were identified, and allowing each individual to represent a single organization, 26 individuals were contacted for the study.[3] The sample included nine individuals from CGIAR centers or programs, nine from the private sector, seven from the CGIAR's membership/donors, and one from academia.

The public-private partnerships highlighted by this study are primarily collaborations involving CGIAR centers and multinational firms in the area of agricultural production technology (Table 3), with an emphasis on agricultural biotechnology. Agricultural biotechnology makes up a very small portion of the CGIAR's research portfolio (about $25 million per annum or 7 percent of the CGIAR's total 2002 budget) relative to conventional plant breeding and other research areas. It is, however, an area where multinational firms can make significant contributions in terms of scientific knowledge and technology or marketing and distribution, areas that may offer new opportunities for small-scale, resource-poor farmers. Given the very small quantity of available documentation on these partnerships, the study is augmented by information gathered from published sources on partnerships in the CGIAR, on other agricultural research collaborations outside the CGIAR, and on partnerships in the health and pharmaceuticals sector. This body of literature includes peer-reviewed journal articles; research papers published by CGIAR centers, international organizations, corporations, universities, and

[3] Although this study does not take a formal approach to surveying the entire population of stakeholders in public-private partnerships, an effort is made to obtain information from a nonrandom sample of individuals representing .private-sector firms and public-sector agencies who are closely familiar with the topic of this study.

non-governmental organizations; and information gleaned from promotional materials and websites.

Table 3--Public-private partnerships in the CGIAR

Partnership Approach Research Topic	CGIAR Center(s)	Private Sector Partners	Other Partners
Collaborative Research – Global Programs			
Apomixis	CIMMYT	Pioneer Hi-bred (U.S.), Syngenta (Switzerland), Limagrain (France)	L'Institut de Recherché pour le Développement (France)
Golden Rice Humanitarian Board	IRRI	Syngenta (Switzerland)	Rockefeller Foundation (U.S.), Swiss Federal Institute of Technology, and others
HarvestPlus	CIAT, IFPRI	Monsanto (U.S.)	
Wheat Improvement[e]	CIMMYT		Grains Research & Development Corp. (Aus.)
Collaborative Research – Local/Regional Programs			
Sorghum and Millet Research[e]	ICRISAT	Consortium of private seed companies, incl. Monsanto (India), others	
Forage Seed Improvement	CIAT	Grupo Papalotla (Mexico)	
Insect Resistant Maize for Africa[e]	CIMMYT		Kenyan Agricultural Research Institute, Syngenta Foundation (Switzerland)
Technology Transfers			
Potato/Sweet Potato Transformation	CIP	Plant Genetic Systems[a] (U.S.), Axis Genetics[b] (U.K.), Monsanto (U.S.)	
Genomics for Livestock Vaccine Research[e]	ILRI	The Institute for Genomic Research (U.S.)	
Bt Genes for Rice Transformation	IRRI	Novartis[c] (Switzerland), Plantech[d] (Japan)	Consortium of other public research institutions
Positive Selection Technology for Cassava Transformation	CIAT	Novartis[c] (Switzerland)	

Sources: Various.
[a] Now Bayer CropScience.
[b] Insolvent as of 1999.
[c] Now Syngenta.
[d] Subsidiary of Mitsubishi.
[e] The definition of a public-private partnership is extended here to include a collaboration between a CGIAR center, on the one hand, and a philanthropic organization established by a commercial entity, or an organization established to represent industry interests, on the other.

3. RESULTS AND FINDINGS

Tentative findings suggest that, of the five hypotheses presented earlier, the three most significant challenges to successful partnership are (a) the lack of creative organizational mechanisms to reduce intersectoral competition for key assets and resources; (b) inadequate accounting for and minimization of direct and hidden costs; and (c) the limited availability of information on successful working models of partnership. While differing incentives and perceptions are also a challenge to partnership, findings suggest that sufficient common space exists or can be created through incentive structuring to facilitate greater partnership. Each of these hypotheses is discussed in detail below.

CONFLICTING INCENTIVES, OVERLAPPING OBJECTIVES

The notion of conflicting incentives between the public and private sectors is an oft-cited impediment to successful partnership. To be sure, public agencies and private firms are subject to very distinct incentives with respect to their research. Profit-maximizing firms invest in research where marginal benefits exceed marginal costs, and thus they tend to partner only where adequate returns can be readily realized. This often implies that private firms engage in research that will potentially result in products—embodiments of their research—that appeal to paying consumers. Public institutions, on the other hand, are typically mandated to research topics of wider social significance with outcomes that possess public goods characteristics (nonexcludability and nonrivalry), require longer time horizons to yield results, or cater to end-users with limited purchasing power or market access.

Comments from several subjects of this study suggest that these differing incentives are a key reason for the limited number of public-private partnerships in agricultural research. A multinational firm that develops, markets, and distributes improved planting materials to farmers

has little reason to seek partnership with a CGIAR center conducting research with a broad, global or regional application. Alternatively, a CGIAR center researching subsistence food crops in sub-Saharan Africa has little reason to engage in partnership with a multinational firm whose research is entirely oriented to high-value horticulture crops adapted for agro-climatic conditions found in Europe or the United States. Given the sectors' fundamentally different incentives, there would seem limited scope for sustained partnership in pro-poor agricultural research in developing countries.

With the emergence of agricultural biotechnology, however, these distinct sectoral incentives are changing. Stronger intellectual property rights regimes are allowing multinational firms to develop marketable products (genes, gene constructs and tools of genetic engineering) from more basic or strategic research outcomes, products that public agencies would otherwise produce for the public domain. Increased recognition of complex, location-specific challenges in agriculture has moved CGIAR research into downstream, location-specific applied research, while recognition of the comparative advantage in its germplasm collection has led the CGIAR toward preservation and characterization of local plant genetic materials.

These changing roles and incentives suggest opportunities for closer interaction. Fundamentally, multinational firms have patented products and processes that CGIAR centers can use to advance their research, while CGIAR centers have plant genetic resources, access to local knowledge resources, or other asset that firms may find equally valuable. This makes claims of conflicting incentives and the absence of common space overstated. Thus, small windows of opportunity or intersecting interests do exist, indicating possibilities for constructive partnership. What remains to be seen is whether overlapping interests can be readily identified,

whether the magnitude of such intersecting interests is significant, and whether policies can be developed to increase the opportunities.

At the same time, the formal or informal rules that shape incentives may generate greater pportunities for partnership. In the pharmaceutical sector, the incentives or economic devices used to improve the availability of drugs and vaccines offer some insight into the variety of options available to the agricultural research sector. Mechanisms designed to reduce the cost of pro-poor R&D ("push" factors) include greater public investment in government research agencies and universities; wider tax credits, deductions and exemptions for private research firms; business grants or preferential lending terms; and other financial transfers to private sector firms (Webber and Kremer 2001). Alternative mechanisms include stronger research exemptions for use of intellectual property; working requirements for intellectual property ownership; compulsory licensing; or exercising of eminent domain by patenting authorities in industrialized countries (Correa 2000; Taylor and Cayford 2003). Mechanisms designed to create or secure markets for pro-poor R&D and increase returns on investment to private firms ("pull" factors) include stronger legislation and enforcement of intellectual property rights; tax credits on sales; or pre-committed purchases by government, private foundations, or other actors (Webber and Kremer 2001).

In the United States, for example, the proposed Vaccines for the New Millennium Act of 2001 offered tax credits for pharmaceutical companies engaged in vaccine R&D for malaria, tuberculosis, and HIV for developing countries, where R&D is largely dependent on limited funding from public agencies, donor governments and international organizations (AVAC 2002). In Europe and the United States, tax deductions and other financial benefits worth millions of dollars motivate companies to look for charitable technology-donation and transfer

opportunities.[4] Yet in the agricultural research sector, exploration of such push and pull factors remain relatively less common.

And with new incentive structures come new sets of questions. The primary issue in both the health and agricultural sectors is whether greater collaboration with the private sector increases corporate influence over priority-setting in research. Corporate participation in priority-setting may steer research toward those problems and technologies that the private sector is most familiar with but are not in the public interest. In the health sector, this is a serious topic of discussion that includes issues such as pharmaceutical companies' influence over World Health Organization policy and practice and the corporate strategy of donating—but not developing—cheaper drugs for diseases prevalent in developing countries (Guilloux and Moon 2001).

In the agricultural research sector, comparable discussions over priority-setting and corporate influence are no less real. The fact that many of the existing public-private partnerships focus on a small set of biotechnological events and spillover research, e.g., insect resistance conferred by genes from the soil bacterium *Bacillus thuringiensis* (Bt), exemplifies how research may be emphasizing a technology that, according to some subjects of this study, is profitable for private firms but relatively poverty-neutral or irrelevant for small-scale, resource-poor farmers in developing countries. Thus, some argue that that partnerships must be subject to vigilant monitoring and review to ensure that public sector priority-setting in research remains uncompromised by the need for financial and intellectual resources from the private sector.

[4] In 1999, the top three donors of pharmaceutical products—Merck, Johnson & Johnson, and Pfizer—donated more than $100 million worth of free drugs and other products. U.S. firms that donate products are entitled to tax deductions equal to the cost basis of the donation, although enhanced deductions equaling twice that amount may be claimed under certain circumstances. In a study of different programs designed to provide drugs and vaccines to developing countries, Guilloux and Moon (2001) find that concessionary pricing and drug-donation approaches impose the highest cost on U.S. taxpayers and reward firms with the greatest tax breaks. Options such as differential pricing or generic drug purchasing impose the least burden on taxpayers but offer insufficient incentives to firms. Ultimately, the study argues that the current system structure militates against those incentives that minimize total cost to society.

In summary, the fundamental incentives motivating public agencies and private firms differ, as do the incentives for engaging in partnership. Nevertheless, common spaces and overlapping interests do exist. Both public agencies and private firms share an interest in serving emerging agricultural markets in developing countries and finding new applications for their research investments, albeit for potentially different clients or different market segments. If more effort is made to identify common spaces and overlapping interests, or if incentives are structured to promote such identification, then public agencies and private companies may have a stronger motive to collaborate.

HIGH COSTS, LITTLE ACCOUNTING

Although overlapping objectives are a necessary condition for successful collaboration between sectors, they are by no means sufficient. Equally important conditions for successful partnership include a feasible research topic; clearly defined project goals; a strategic, well-planned, time-bound approach; and measurable benchmarks and outcomes. Fulfilling such conditions requires the usual prerequisites of a good project: effective governance and leadership, accountability and transparency, strong monitoring and evaluation systems, flexibility in structure and process, resiliency and durability in crisis, and continuity across changes in leadership or objectives.

To meet these conditions, however, each partner incurs certain costs which, when compared with the partnership's benefits, affect their willingness and ability to collaborate. Thus, a useful way of looking at the challenges to successful partnership is to identify the costs involved—actual outlays as well as transactions costs, opportunity costs, and the costs of managing risk and uncertainty—and the manner in which they are distributed between parties. This study finds that partners do not adequately account for or minimize the actual and hidden

costs of public-private partnership, making it difficult to determine the rates of return and cost-benefit ratios of collaborative agricultural research.

Transactions Costs

Comments from subjects of this study indicate that transactions costs in public-private partnerships are often excessively high, a fact common where the collaboration centers around the use and exchange of scientific knowledge and technology, and where contracts can be relatively difficult to enforce. For public agencies and private firms, transactions costs include expenses associated with employing or contracting legal counsel to formulate memoranda of understanding, confidentiality and nondisclosure agreements, material transfer agreements, licensing agreements for intellectual property use, or other legal documents that set forth the terms and conditions of a technology exchange. Other transactions costs are incurred where partners operate along different time horizons, at different speeds, or from different organizational cultures. These costs include the time required to bring parties to the table to agree on mutually acceptable terms and conditions for collaboration or the effort required to adapt to a partner's way of conducting business. Still other costs accrue from efforts required to obtain information about a prospective partner, whether through repeated meetings, casual dialogues or background research. These types of costs may be particularly high for public agencies with limited experience dealing with the private sector or without in-house or external legal counsel.

There are several immediate examples of transactions cost and cost management in public-private partnerships. Transactions costs are significant in public-private partnerships in agricultural research. The Golden Rice Humanitarian Board—a collaboration that includes Syngenta, the International Rice Research Institute and the Rockefeller Foundation, among

others—was formed in part to manage transactions costs arising from efforts to disentangle the complex web of intellectual property ownership associated with key technologies, and a lack of *ex ante* good-faith agreements over the use of private-sector intellectual property used by the original academic researchers. The Insect-Resistant Maize for Africa project, a collaboration between the Syngenta Foundation, the Kenyan Agricultural Research Institute (KARI), and the International Maize and Wheat Improvement Center (CIMMYT), takes a different approach. By using only intellectual property (genes and gene constructs) developed by public research agencies and available in the public domain, the project minimizes transactions costs associated with expending the time, effort and money needed to negotiate licenses for research or eventual commercialization with private firms. Collaborative research on virus-resistant sweet potato undertaken by Monsanto and KARI, and similar research on virus-resistant papaya by Monsanto, Syngenta and the national agricultural research systems in Southeast Asia, minimize transactions costs with explicit agreements over intellectual property use and implicit good-faith agreements over commercialization to reduce possible entanglements over the distribution of benefits from research outputs (Cohen et al. 2000; Shear 2000; ISAAA 2003). Bt rice research undertaken by International Rice Research Institute (IRRI) and a consortium of public research institutions minimized transactions costs by purchasing a Bt gene directly from Plantech, a Japanese firm, while maintaining an option to later buy the gene for commercialization purposes (IRRI 1996).

Opportunity Costs

Comments from subjects of this study also indicate that opportunity costs are a significant issue in public-private partnerships. Private firms must implicitly choose between investing in either research that improves corporate profitability in the shorter term and increases returns to shareholders, or pro-poor research collaborations that focus on technologies that have

limited commercial value, high levels of uncertainty, or long time horizons. Public agencies must similarly choose between research investments that rely on tried-and-tested, in-house research and experimental partnerships with private firms about which little may be known. These costs, amplified by pressures to engage in intersectoral partnership, make research expenditure allocation and priority-setting a difficult task.

Social planners—a broad term used to describe agents charged with allocating scarce public resources in a given economy—may also be concerned with the notion of opportunity costs. Tax deductions and other incentives for technology donations given in developing countries necessarily require the redistribution of resources from taxpayers to corporate entities. Yet these types of transfers may reduce the sum total of resources available for welfare-improving projects, and they may impose costs on those least able to bear them. Furthermore, corporate donation programs have several drawbacks: they are often cyclical and unsustainable in the long run; restricted in quantity, geography, and duration; and distortionary with respect to research incentives, pricing, and rational usage in developing country markets (Guilloux and Moon 2001).[5]

Risk Management Costs

Comments from subjects of this study also suggest that the costs of risk management in public-private partnerships are another issue for concern. Such costs are incurred when agents undertake measures to minimize the liabilities of potential hazards or adverse occurrences that are probabilistic or unknown factors arising from a collaborative research project. Ideally, partnerships are designed to reduce and distribute risks associated with a given research problem.

[5] Although Guilloux and Moon (2001) study drug-donation programs, their arguments can be extended to the donation of agricultural technologies as well. Donations of agricultural technologies to pro-poor research partnerships may have distortionary effects if the donation stimulates a shift in research away from more appropriate technological alternatives or away from cheaper suppliers of similar technologies.

With multiple participants and a greater diversity of funding, public agencies and private firms share the costs of a research investment with an unknown outcome, thereby reducing their financial liability. Partnerships are an opportunity to spread the costs of such undertakings across several actors, each risking a smaller portion of its available resources.

Yet partnerships themselves are not without risk. The single largest risk to public and private partners is the potential misuse or controversial use of a proprietary technology by partners, end users, or third parties. This risk of good stewardship presents a wide range of legal, financial, and reputational liability to the technology provider—typically, the private firm—even where recipient partners assume liability and waive corporate responsibility. Moreover, the risk is exacerbated in partnerships that engage multiple parties in research, conduct research in countries where biosafety regimes are weak, or are subject to a high degree of public scrutiny because of the use of controversial technologies. For both the private firm and the public agency, the costs of managing such risks can exceed the partnership's intended benefits. This becomes a particularly important issue as parties to the recently-ratified Cartageña Protocol seek to develop rules and procedures for liability and redress of damages resulting from international movements of living modified organisms pursuant to Article 27 of the Protocol.

Public agencies also face risks in public-private partnerships that are primarily reputational. By associating with large multinational interests and controversial technologies, public agencies often attract uncomfortable attention and scrutiny from staff and colleagues, "watchdog" organizations, the media, or the general public. This situation was made apparent at the CGIAR's Annual General Meeting in 2002, when the NGO Committee chose to freeze its participation because it felt the CGIAR had failed to respond to allegations that genetically

modified maize had contaminated maize's center of genetic diversity in Mexico (ETC Group 2002).

Several organizational forms of public-private partnership offer creative strategies to minimize the costs of managing risk. Risk management costs can be reduced through a joint venture approach to partnership in which public and private collaborators create a legal entity to manage and execute the research. Alternatively, risk management costs can be reduced through a "quasi-corporate" approach in which public agencies establish research entities that exhibit characteristics of both a public agency and a private firm to promote a public interest research agenda (Mitchell-Weaver and Manning 1990). In China, for example, one finds several examples of research in agricultural biotechnology being undertaken by commercial ventures spun off from public research agencies, often wholly or majority owned by the parent agency (Huang et al. 2002; Pray et al. 2002). The revenues generated by the commercial venture strengthen the financial sustainability of the vested public agency, while the commercial venture's close association with a public agency arguably minimizes the venture's financial risks. While this approach has wider implications for public expenditure and the state's role in the economy, it is not without precedent in both industrialized and developing countries.

A more common approach, however, may be the use of an "honest broker" or a third-party actor to manage the research and assume responsibility for the use of proprietary knowledge and technology. This approach is illustrated by organizations such as the International Service for the Acquisition of Agri-biotech Applications (ISAAA) and the African Agricultural Technology Foundation (AATF), discussed in detail below. However, the ability of these intermediaries to manage the risks and associated costs of good stewardship remains unknown and untested. Would they be able to withstand the controversy generated by a

mishandling incident—for instance, the entry of Aventis's Starlink® corn into the U.S. food supply chain in 2000, which demonstrated how rapidly real and perceived risks can create significant liability for corporate technology providers?

In summary, however, there is still little evidence to suggest that public- and private-sector partners are adequately accounting for and minimizing the transactions, opportunity and risk management costs of partnership. Rather, parties make vague assumptions that short-term costs are negligible and can be overcome through durable, long-term collaborations between sectors. This may be true to some extent. For example, public agencies and private firms realize cost savings with experience gained from navigating the regulatory processes, testing procedures, and commercialization requirements of a specific country. This is a particular attribute of many partnerships based on the development and commercialization of agricultural biotechnology applications. Further, public agencies realize cost savings with access to proprietary information about private-sector research into problems that are already proven dead ends. This may be the case as the CGIAR expands into crop biofortification research through its HarvestPlus Challenge Program, where the private sector's relatively larger body of experience in the field may help identify or avoid redundant research. Having said this, however, more analysis of costs and savings are required to fully understand the rates of return and cost-benefit ratios associated with public-private partnership: a full accounting of the costs of public-private partnerships is a critical prerequisite to fully understanding the opportunities for, and challenges to, successful collaboration.

DIFFERENT PERCEPTIONS, DIFFERENT REALITIES

Real and perceived cultural and ideological differences may also affect the willingness and ability of public agencies and private firms to enter into partnership. Comments from

subjects of this study suggest that individual managers and researchers in the public sector view large multinational firms with suspicion, while researchers in such firms view public agencies as inefficient and resistant to change. While there may be some truth to these perceptions, they are more often unfounded impediments to successful partnership between sectors. Yet there is little research on the topic of perceptions in public-private partnership, even despite the felt need for greater intersectoral dialogue and scientific interaction.

What are the origins of this mistrust and suspicion? The confidentiality and nondisclosure agreements that accompany many public-private partnerships are a likely source of tension given how alien they are to public-sector researchers. These agreements not only prevent public researchers from sharing knowledge with colleagues but also generate suspicion among third-party actors who observe or involve themselves in the public research agenda. For example, the secrecy surrounding CIMMYT's apomixis research, including the removal from circulation of the CIMMYT-based *Apomixis Newsletter* in 1999, may contribute to misperceptions and suspicions of the private sector and of public-private partnerships among some CGIAR researchers (GRAIN 2001). Having said that, these attitudes may also result from what some subjects of this study regard as an inward-looking, exclusionary attitude common among CGIAR centers and researchers.

In other cases, the origins of misperception may lie in the relative distribution of bargaining power between partners. Public agencies may be unwilling to engage private firms where the firm can potentially dominate the partnership by virtue of its organizational size, the value of its intellectual property, the size of its research budget, or its ability to influence political and economic decision-makers. Thus, many of the CGIAR's public-private partnerships, for example, are not with large multinational firms with advanced biotechnologies to offer, but with

small, local companies that seek out center expertise and technologies—an arrangement that places the center in a more opportune bargaining position. Seed projects in the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT), and CIMMYT, for example, work closely with local companies to develop and disseminate improved planting material. Science parks at ICRISAT and CIAT are being designed to support local research start-up firms to improve scientific capacity in plant breeding and related scientific endeavors. Projects led by the International Service for National Agricultural Research (ISNAR) and CIAT are working with local agro-processing firms to promote value-added agricultural products for markets. It is reportedly even the case that some centers are pursuing collaborations with local subsidiaries of leading multinational firms—undertakings that are arguably viable so long as the centers perceive their partners to be small, local firms. Such partnerships affirm the center's position as the "majority" partner in the collaboration, a position that centers would likely prefer to be in even when dealing with multinational firms.

The origins of misperceptions may also be related to concerns about good stewardship, an issue discussed earlier. There is some apprehension among private firms that their public counterparts are ill-equipped to undertake the necessary safety precautions to ensure good stewardship and manage liabilities associated with advanced, proprietary biotechnologies, particularly when operating in countries where biosafety regulations are inadequate. These concerns will likely affect the viability of partnerships until such time as the CGIAR can address the private sector's real and perceived biosafety concerns in the centers' laboratories and test fields, and in those of their national partners and other parties to collaborative research.

Finally, misperceptions may originate from the different ways in which the sectors conduct business. Private sector decision-makers are often frustrated by the slow pace at which decision making and financial allocations proceed in the public sector. Endless meetings, dialogues, workshops, and seminars may prevent those actions from being taken in a timely manner to make the best of a new opportunity. Naturally, the public sector's more measured response to opportunity comes from its responsibility to a wider set of stakeholders within and beyond its organizational structure. Nonetheless, the differences in organizational culture do affect the willingness and ability of public and private actors to collaborate on important research issues, indicating that there may be room for improvement.

The importance of perceptions also raises the issue of ethics in public-private partnership. If partners or observers to a partnership find an aspect of the collaboration in some way unethical, then any real or perceived controversy (or even potential for controversy) could impede partners from achieving their stated objectives, both singularly and jointly. To avoid this possibility, should partners, especially public agencies, have some code of ethics or conduct to govern their interactions with other sectors and to ensure that their image benefits from the collaboration? Should researchers be asking whether the collaboration is, in fact, ethical, or in compliance with some minimum health, environmental or social standards that govern the organization, industry, or sector? The health sector continues to struggle with this issue, and the World Health Organization has arrived at a policy that keeps it at arm's length from tobacco companies because of the public health issues created by that industry's product (Roberts et al. 2000; Seoane, pers. comm.). The CGIAR and its centers, however, seem to impose fewer restrictions on their partnerships, restrictions that might exclude centers from partnering with petroleum, chemical, or tobacco companies (or their charitable foundations) whose products or

production processes are at odds with the CGIAR's mission. A better understanding of these issues and more answers to these questions could affect perceptions of private-sector partners not only among CGIAR researchers but among third-party partners and watchdog organizations as well.

To be fair, perceptions are changing. Ideological constraints—real and perceived—may be of lesser importance as public agencies and private firms identify more common space in which to collaborate. At the same time, the CGIAR and several of the larger, more advanced NARS of developing countries are building capacity to address legal issues over intellectual property rights, biosafety, and good stewardship, thereby improving their capacity to deal with the private sector. Moreover, greater effort is being made to mine the goodwill and collegiality that exist between the public and private sectors, and the mutual, personal interests in conducting research in the public interest. Finally, the mode of intersectoral engagement may also be changing from secretive collaboration to more open partnership. With greater intersectoral contact and dialogue, perceptions can be improved so that more opportunities for synergistic research can be exploited in a manner that is transparent and accountable.

COMPETITION VERSUS COOPERATION

The fundamental issue in many of the public-private partnerships in agricultural research described here is competition—over the ownership and use of scientific knowledge and technology, over scarce financial resources for research, and over markets, clients, and beneficiaries. Competition undermines the willingness and ability of public- and private-sector researchers to collaborate on pro-poor research topics too large or complex for a single organization to undertake. Overcoming these constraints depends partly on the ability of public

and private actors to develop creative arrangements and mechanisms to reduce competition between the sectors.

The primary source of competition between sectors is over the ownership and use of scientific knowledge and technology. Although material transfer agreements, licensing agreements, and technology donations are standard mechanisms for sharing scientific knowledge and technology between sectors and promoting research and the freedom-to-operate principle, they are an inadequate means of reducing competition over proprietary knowledge and technology, and an insufficient way of addressing the agricultural research challenges facing many developing countries. Creative approaches to public-private partnership could provide alternative ways of reducing this competition by increasing the ability of partners to establish, monitor, and enforce the terms and conditions for intellectual property use and the appropriation of benefits.

Another source of competition exists where public and private assets are inadequately mapped to ensure that research complementarities are fully exploited within a partnership. As illustrated by Byerlee and Fischer (2001), there is significant complementarity of assets and resource held by public agencies and private firms that could benefit pro-poor agricultural research (Table 4). However, comments from subjects of this study suggest that there is insufficient recognition of these complementarities and inadequate understanding on how to distribute the benefits generated by application of these complementarities.

Looking at the public-private partnerships in which the CGIAR is engaged, it would seem that the CGIAR exploits its regional and global network assets to bring together otherwise distant and disparate actors. In several biotechnology research partnerships, a CGIAR center brings together the local knowledge and infrastructure held by a NARS with the advanced technological

capacity of a multinational firm. In other, more product-oriented partnerships, the center brings together the distribution and marketing infrastructure of local firms and its own research capacity. In the future, some expect that the centers, in partnership with national research agencies and private firms, will use their experience, authority, and reputational integrity to effect improvements in biosafety regulation and scientific capacity building, key prerequisites for private-sector investment in agricultural research. However, the small number of partnerships suggests that complementary assets have not been adequately identified or exploited to reduce competition between the public and private sectors.

Table 4--Asset complementarities in agricultural research

Institution/Firm	Scientific & Knowledge Assets	Other Assets
Multinational Research Firms (Life-Science Firms)	• genes, gene constructs, tools, related information resources • biotechnology research capacity	• access to int'l markets and marketing networks • access to int'l capital markets • access to philanthropic funding • economies of market size • decision-making speed and flexibility
International Agricultural Research Centers (CGIAR)	• germplasm collections and informational resources • conventional breeding programs and infrastructure • applied/adaptive research capacity	• access to regional/global research networks • access to bilateral/multilateral donor funding • generally strong reputational integrity •
National Agricultural Research Systems (NARS)	• local/national knowledge and materials • conventional breeding programs and infrastructure • applied/adaptive research capacity	• seed delivery and dissemination programs and infrastructure • generally strong reputational integrity
Local firms	• local/national knowledge and materials • applied/adaptive research capacity	• seed distribution and marketing infrastructure

Source: Adapted from Byerlee and Fischer 2001.

Yet another source of competition exists where the ultimate beneficiaries or end users are insufficiently defined or where the benefits of research are inadequately distributed between public and private partners. An early example is the failure to reach an agreement over the transfer of genes and transformation technology between ICI Seeds (Zeneca) and the Central Research Institute for Food Crops in Indonesia due to insufficient intellectual property protections (Lewis 2000). This implies the need for negotiated agreements that delineate how markets for research outputs are segmented. Again, expanding on Byerlee and Fischer (2001), market segmentation may entail placing limits on the use of proprietary technologies or research outputs according to

- crop or variety—limiting use to those crops or crop varieties that are produced or consumed primarily by small-scale, resource-poor farmers or other vulnerable agents;
- locality, country, or region—limiting use to areas that are predominantly populated by small-scale, resource-poor farmers or other vulnerable agents, as determined by income level or geographic delineation; or
- end-user—limiting use to crops that are consumed domestically only and not for export.

Several public-private partnerships take this approach. In Kenya, for instance, KARI received training and technology from Monsanto to develop virus-resistant sweet potato for use only in the region (Cohen et al. 2000; Shear 2000). In Southeast Asia, Zeneca provided genetic material to several NARS to develop delayed-ripening traits for papaya but licensed the technology for local, non-export use only (Byerlee and Fischer 2001). And after the experience with ICI Seeds and CRIFC mentioned above, ABSP and USAID took steps to address intellectual property rights as a condition in subsequent public-private partnerships. Still, there is little evidence to suggest that new research partnerships have expanded on these types of

arrangements or innovated on these terms and conditions to reduce intersectoral competition and clear a path for greater collaboration.

Finally, competition exists where financial resources are so scarce as to affect the distribution of negotiating power in a partnership. Part of the problem may be what some characterize as a paradox of intersectoral collaboration. In a climate of funding scarcity, a public agency may respond to a research problem by excluding other, potentially useful research partners if it believes that the partnership will shift attention away from its wider priorities and objectives, compromise the agency's mandate or mission, or divert resources from actual research to managing intersectoral transactions. Rather than identify new sources of knowledge and financing, public agencies respond to partnership by looking inward and assuming the full spectrum of research responsibilities—priority-setting, financing and execution.

This may suggest the need for a separation between research priority-setting and financing, on the one hand, and research execution, on the other. An oft-cited solution to this problem is the use of third-party brokers or institutions to secure access to proprietary knowledge and technology, to absorb some of the costs and liabilities associated with partnership, and to manage and supervise research execution (Van der Meer 2002; Byerlee and Fischer 2001). To achieve this, the third-party broker must be a competent, independent entity vested with the capacity and authority to marshal participation from both sectors and independently negotiate the terms and conditions for the research undertaking. This arrangement minimizes the perception in public agencies that private companies are competing for resources, a perception that often reduces realization of shared research opportunities.

The arrangement makes for an efficient allocation of management and scientific expertise in particularly large or complex research undertakings. Moreover, the approach is, arguably, an

application of the principles of subsidiarity, one of the CGIAR's main tenets. Subsidiarity holds that the primary responsibility for a research activity must be devolved to the lowest-level organization within the international agricultural research system's hierarchy to ensure that activities are carried out most appropriately (CGIAR 1998, 17). It may be a more effective approach to public-private partnerships if primary responsibility for research execution is devolved to some entity that executes the research.

There are many constructive examples of third-party brokering of partnerships. Michigan State University acted as a contractual intermediary between public and private participants in the Agricultural Biotechnology Support Program (ABSP), an undertaking that encompassed research projects in several developing countries with funding from USAID (Lewis 2000). The International Service for the Acquisition of Agri-biotech Applications and the African Agricultural Technology Foundation were established with the primary purpose of brokering public-private collaboration in agricultural research. Already, ISAAA is involved in implementation of several agricultural biotechnology projects in Asia and sub-Saharan Africa. Other third-party organizations such as the Rockefeller Foundation are playing a convening and financing role for projects such as Golden Rice. Still, there is little independent analysis of the role played by these types of organizations, and little evidence to suggest that the use of third-party brokers is becoming popular in the CGIAR as a means of minimizing competition with the private sector.

An alternative approach to minimizing competition would simply be to dispense with partnerships with strictly corporate entities and instead focus on partnerships with private-sector "humanitarian" projects or charitable, non-profit extensions of corporate entities. This approach might reduce the liabilities to public agencies that come from associating with a multinational

firm and may instead bring together institutions with similar mandates and cultures. A comparison of the costs and risks associated with CIMMYT's partnership with Syngenta (in the apomixis research project) and its philanthropic wing, the Syngenta Foundation (in the Insect-Resistant Maize for Africa project), would shed more light on this issue.

Potentially, public-private partnerships represent a more effective means of addressing large and complex research problems in developing country agriculture because they combine intellectual resources with human capital, financial resources, institutional support, and complementary, synergistic potential. Yet the gains from cooperation and collaboration depend significantly on the ability of public and private actors to develop creative arrangements and mechanisms that reduce competition between sectors.

LIMITED INFORMATION, TOO FEW MODELS

Despite the many types of public-private interaction—research collaborations, technology transfers, research networks—there is limited information on the topic available in the public domain. And what information does exist is often difficult to access or of limited analytical use. This is particularly true with respect to public-private partnerships in the CGIAR, where centers may be reluctant to disclose their partnerships because of continued ambiguity over intellectual property rights policy in the CGIAR; the competitive, confidential nature of agricultural biotechnology research; and the persistence of public controversy over biotechnology.

The ISNAR Biotechnology Service may represent the CGIAR's most significant effort to accumulate and analyze information on agricultural biotechnology research (ISNAR 2003; Komen 2000). However, the CGIAR and its private-sector partners have not compiled a detailed inventory of their collaborations comparable to, say, the high-quality database maintained by the

Initiative for Public-Private Partnerships for Health.[6] The absence of technical discussions of the costs and benefits of partnership, as well as their terms and conditions, potentially hinders the ability or willingness of public- and private-sector actors to engage in partnerships. Ultimately, more information on working models is needed, including information on different approaches to specific research topics, to sharing scientific knowledge and technology, to intellectual property rights management and use, and to different types of partners (Annex B).

Yet several subjects of this study expressed a concern that, in conjunction with such an inventory, the CGIAR will seek to improve the environment for public-private partnership by developing rigorous guidelines, frameworks, and directives to govern such interactions. Realistically, the impact of this approach is limited, especially if they are developed in a top-down manner.[7] Moreover, guidelines and frameworks are by and large irrelevant to potential partners in the private sector, where organizational culture is more geared toward a "get things done" approach to decision making. In other words, the situational specificity of public-private partnership opportunities renders guidelines and frameworks of little practical use to CGIAR centers, multinational firms, or their national counterparts.

[6] Despite the growing popularity of public-private partnerships, there are few efforts to inventory or detail collaborations in a given sector. This issue figures prominently in a study of the relationship between U.S. universities and private sector research firms (Ervin et al., 2003). In the health sector, the Initiative on Public-Private Partnerships for Health (IPPPH) represents a key informational resource on collaborations on neglected health problems in high disease-burden countries. Through events, publications and its internet portal, IPPPH provides news, analysis and data on public-private partnerships. One of the initiative's innovations includes a database that serves as a central source for updated and strategic information on partnerships. The database profiles 90 public-private partnerships, and includes information on disease/condition, approach, product/service, location, stakeholders, legal status and date established.

4. CONCLUSIONS AND RECOMMENDATIONS

Although information on public-private partnerships in agricultural research is difficult to access, shrouded in secrecy, or the subject of extensive controversy, this study attempts to assess the opportunities for, and challenges to, creating and sustaining partnerships between the CGIAR and the leading multinational research firms. Based on the preceding discussion, we tentatively conclude that public-private partnerships are significantly constrained by insufficient accounting of the actual and hidden costs of partnership; persistent negative perceptions across sectors; undue competition over financial and intellectual resources; and a lack of working models from which to draw lessons and experiences. Despite these constraints, however, there is reason to believe that sufficient common space exists to create greater opportunities for public-private partnership in pro-poor agricultural research.

More research and analysis is needed to identify solutions to these problems, and more discussion is needed to better understand the ground realities associated with their implementation. To this end, several steps can be taken at the present time to create an environment more conducive to public-private partnership. They are as follows.

1. Compile and maintain an analytical inventory/database of public-private partnerships in the CGIAR and, more generally, in national agricultural research systems of developing countries from which lessons may be learned.
2. Identify feasible research problems and opportunities that require research inputs from both the public and private sectors and are immediately relevant to small-scale, resource-poor farmers and other vulnerable agents in developing countries.
3. Increase the frequency and technicality of dialogue between the sectors to reduce negative perceptions and foster understanding of potential research opportunities, and

[7] An exception to this is in the area of intellectual property rights, where interviewees indicated that the CGIAR needs a more coherent strategy and stronger guidelines on intellectual property rights at the system level.

make the dialogues attractive and constructive forums for decision-makers from both sectors.

4. Improve the quality of cost-benefit analysis of partnerships and make available information on terms and conditions used in agreements to manage risk and liability.
5. Explore the creative use of third-party brokers and other mechanisms to separate research priority-setting and financing from research execution.
6. Engage in a multi-stakeholder discussion on public-private partnerships and agricultural biotechnology research with a wider audience, even despite the implications of controversy and conflict that such interactions may entail.

If public- and private-sector actors are willing and able to take these steps, both may realize the potentially significant benefits of greater intersectoral collaboration, including improved access to scientific and financial resources, new synergies in research, access to new and emerging markets, and greater capacity to solve problems that cannot be addressed by a single actor. Most important, greater public-private partnership may contribute to the improvement of livelihoods for small-scale, resource-poor farmers, food-insecure urban and rural households, and other vulnerable individuals and households in developing countries.

ANNEX A: INTERVIEW QUESTIONS

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty

2033 K Street, NW
Washington, DC 20006-1002 USA
Tel: +1.202.862.5600
Fax: +1.202.467.4439
Email: ifpri@cgiar.org
www.ifpri.org

September 30, 2003

Dear colleague,

The International Food Policy Research Institute (IFPRI) is conducting research on the challenges to creating and sustaining research partnerships between the private sector and the Consultative Group on International Agricultural Research (CGIAR).

In the first phase of this research, we are conducting interviews with individuals such as yourself to learn about your experiences with public-private partnerships. In this context, public-private partnerships are defined as a sustained, collaborative effort between the public and private sectors in which each contributes to the planning and resources needed to accomplish a mutual objective.

While there have been many efforts to form partnership between the CGIAR and the private sector, examples of successful and sustained cooperation are few. Consequently, opportunities may have been lost both for poverty reduction and for facilitating market-based development in low-income countries. This is a source of great concern to IFPRI, and a problem it intends to treat as a policy research issue.

Thus, we are interested in learning about your views on public-private partnerships. Specifically, we are interested in learning about missed opportunities for collaboration between the CGIAR and private companies that could have significantly benefited agricultural development and poverty reduction in developing countries.

The attached set of questions (along with this cover) is designed to elicit your interest in these issues. If you feel that you can provide us with useful input, please notify David J. Spielman (d.spielman@cgiar.org, 202-862-5695) or Klaus von Grebmer (k.vongrebmer@cgiar.org, 202-862-5611) so we may discuss these issues with you by telephone at a mutually convenient time.

It is our hope to take just 15 minutes of your time to cover the important issues as you see them. If, however, you feel unable to provide input, please notify us all the same.

Sincerely,

Klaus von Grebmer
Director, Communications Division

David J. Spielman
Project Manager, Public-Private Partnerships

Interview Questions on Public-Private Partnerships

1. Are you aware of any partnerships between the public and private sectors that were important, but did not happen?

2. If so, please describe the topic of the (foregone) partnership, i.e., what partners could have been involved, and what technologies, crops, regions, or target groups were being explored.

3. Please describe why the partnership did not materialize, i.e., what were the major problems *for your organization?* (e.g., communication with partner organization, negotiating use of proprietary knowledge, agreeing to legal provisions, etc.)

4. Briefly describe what motivated your organization's interest in the partnership, i.e., what were the major benefits or outcomes from the partnership *for your organization?* (e.g., a new technology, training and scientific capacity improvement, new tools and equipment, enhancement of organizational image, etc.)

5. Please describe your impressions of the (public/private) by answering the following questions.

a. The (public/private) sector is a scientifically able and competent partner.

1	2	3	4	5
(strongly agree)	(agree)	(don't know)	(disagree)	(strongly disagree)

b. The (public/private) sector is a trustworthy partner.

1	2	3	4	5
(strongly agree)	(agree)	(don't know)	(disagree)	(strongly disagree)

ANNEX B: PROPOSED SURVEY ON PUBLIC-PRIVATE PARTNERSHIPS

1. Project Name:

2. Date of Establishment:

3. Duration:

4. Location(s) of Activities:

5. Public Sector Participants (name, country of origin, status):

6. Private Sector Participants (name, country of origin, status):

7. Other Participants (name, country of origin, status):

8. Project Objectives (describe):

9. Legal Status (choose one):
    a. Public Sector Host
    b. Private Sector Host
    c. Non-Profit Host
    d. Independent Legal Status
    e. Other

10. Project Approach (choose all that apply):
    a. Basic/Strategic Research –
    b. Product Development –
    c. Access Improvement –
    d. Coordination Mechanism –
    e. Capacity Strengthening –
    f. Safety, Regulatory Assurance –

11. Outcomes (Actual/Expected) (choose all that apply):

    a. Input Technology –
    b. Output Technology –
    c. Service/Extension –
    d. Data and Information –
    e. Other –

12. Public Sector Financing:
    a. source
    b. duration
    c. status
    d. amount
    e. conditions (if any)

13. Private Sector Financing:
    a. source
    b. duration
    c. status
    d. amount
    e. conditions (if any)

14. Other Financing:
    a. source
    b. duration
    c. status
    d. amount
    e. conditions (if any)

15. Management and Execution Structure:

16. Governance and Supervision System:

17. Provisions for Monitoring & Evaluation:

18. Key Terms and Conditions of Partnership:

19. Technology Transfers (description, use, ownership):

20. Terms of Technology Use:

21. Key Provisions for Risk and Liability Management:

22. Agreements on Distribution of Benefits:

23. Legal Agreements in Effect:
    a. Memorandum of Understanding –
    b. Material Transfer Agreements –
    c. License for Research Use –
    d. License for Commercialization –
    e. Confidentiality/Non-Disclosure –
    f. Other –

REFERENCES

AIDS Vaccine Advocacy Coalition (AVAC). 2003. Legislation: Incentives proposed in the US Congress for AIDS vaccine research and delivery. <http://www.avac.org/actionLeg.htm>. Accessed December 15, 2003.

Agricultural Biotechnology Support Project (ABSP). 2003. The agricultural biotechnology support project, building capacity in biotechnology research and policy. Institute of International Agriculture. East Lansing, MI: Michigan State University. <http://www.iia.msu.edu/absp/>. Accessed September 30, 2003.

Barry, G. and R. Horsch. 2000. Evolving role of the public and private sector in agricultural biotechnology for developing countries. In *Agricultural biotechnology and the poor,* ed. G. J. Persley and M. M. Lantin. Proceedings of an International Conference, October 21 and 22, 1999 in Washington, D.C. Washington, D.C.: Consultative Group on International Agricultural Research (CGIAR).

Binenbaum, E., P.G. Pardey and B.D. Wright. 2001. Public-private research relationships: the consultative group on international agricultural research. *American Journal of Agricultural Economics* 83(3) (August 2001): 748-753.

Buse, K. and G. Walt. 2000a. Global public-private partnerships: part i – a new development in health? *Bulletin of the World Health Organization* 78(4): 549-561.

———. 2000b. Global public-private partnerships: Part II – what are the health issues for global governance*?* *Bulletin of the World Health Organization* 78(5): 699-709.

Buse, K. and A. Waxman. 2001. Public-private health partnerships: A strategy for WHO. *Bulletin of the World Health Organization* 79(8): 748–754.

Buurma, J.S. and D.M. Boselie. 2000. Stakeholder perception analysis for agri-supply chain development. *Acta Horticulturae* 536: 625-33.

Byerlee, D. and K. Fischer. 2001. Accessing modern science: Policy and Institutional options in developing countries. *IP Strategy Today* 1. <http://www.biodevelopments.org/ ip/ipst1n.pdf>. Accessed December 19, 2003.

Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT). 2003. Wheat in the developing world and apomixis. <http://www.cimmyt.org>. Accessed October 2, 2003.

Centro Internacional de la Papa (CIP). 1998. Belgian technology contributes to developing-country food security: The story of potato, the potential for sweet potato. <http://www.cipotato.org/ Market/Belgtech/belgtech.htm>. Accessed November 7, 2003.

Charles, C. and S. McNulty. 1999. *Partnering for results: Assessing the impact of inter-sectoral partnering.* Washington, D.C.: Academy for Educational Development and United States Agency for International Development, Document No. PN-ACG-107, October 15, 1999.

Charles, C.L., S. McNulty and J.A. Pennell. 1998. *Partnering for results. A user's guide to intersectoral partnering.* Study prepared and presented at the U.S. Agency for International Development Mission Directors' Conference, November 1998.

Citizens International. 2003. What we do: Agricultural competitiveness. <http://www.citizensintl.com/CI_agri.html>. Accessed November 12, 2003.

Cohen, J. I., C. Falconi, and J. Komen. 2000. Perspectives from international agricultural research centers: ISNAR. In *Intellectual property rights in agriculture*, ed. U. Lele, W. Lesser, and G. Horstkotte-Wesseler. Environmentally and Socially Sustainable Development Series, Rural Development 2. Washington, DC: World Bank.

Consultative Group on International Agricultural Research (CGIAR). 1999. *Report of the Tenth Meeting of the CGIAR Private Sector Committee, Hattersheim, Germany, March 11-12, 1999.* Meeting Report. Washington, D.C.: CGIAR

———. 1998. *The International research partnership for food security and sustainable agriculture: Third system review of the consultative group on international agricultural research*. Washington, DC: CGIAR Secretariat.

———. 1997. Strengthening CGIAR-private sector partnerships in biotechnology: a private sector committee perspective in compelling issues. Paper Prepared for the CGIAR Mid-Term Meeting, 1997, May 26-30, 1997, Cairo, Egypt.

Correa, C. 2000. *Integrating public health concerns into patent legislation in developing countries.* The South, Geneva, Switzerland.

De Bruijn, J.A. and H.G. van der Voort. 2002. *Public-private partnership in scientific research: a framework for evaluation.* Study commissioned by the Consultative Committee of Sector Councils for Research and Development, the Netherlands.

Department for International Development (DfID). 2003. *List of DfID Funded Projects Involving the Potential Release of Genetically Modified Organisms (GMOs) and Studies on GM Issues*. <http://www.dfid.gov.uk/AboutDFID/files/epd/GMOw1a.doc>.

Dosi, G., C. Freeman, R. Nelson, F. Silverberg and L. Soete, eds. 1988. *Technical change and economic theory.* London: Pinter.

Driscoll, J., G.L. Cowger and R.J. Egan. 1979. SMR Forum: Private managers and public myths—public managers and private myths. *Sloan Management Review* 21(1) (Fall, 1979): 53-57.

Ekboir, J. and G. Parellada. 2002. Public-private interactions and technology policy in innovation processes for zero tillage in Argentina. In. *Agricultural research policy in an era of privatization,* ed. D. Byerlee and R. Echeverría.. Oxon, UK: CABI.

Ervin, D., T. Lomax, S. Buccola et al. 2003. University-industry relationship: framing the issues for academic research in agricultural biotechnology. Proceedings from an expert workshop sponsored by the Pew Initiative on Food and Biotechnology and the U.S. Department of Agriculture's Initiative for Future Agriculture and Food Systems Project Public Goods and University-Industry Relationships in Agricultural Biotechnology. Charles Hammer Conference Center, November 19-20, 2002, Research Triangle Park, NC.

ETC Group. 2002. Trouble in paradise: C*ivil society denounces CGIAR for denial of GM contamination in Mexican centre of genetic diversity*. Press release, October 31, 2002.

Etzioni, A. 1973. The third sector and domestic missions. *Public Administration Review* 33: 314-323.

Fondo Latinamericano para Arroz de Riego (FLAR). 2003. FLAR. <http://www.flar.org/>. Accessed October 15, 2003.

Global Forum on Agricultural Research (GFAR). 2003. Parallel sub-plenary sessions on global & inter-regional partnership programmes. In GFAR, *Linking research and rural innovation to sustainable development, 2nd triennial GFAR Conference,* May 22-24, Dakar, Sénégal. <http://www.egfar.org/gfar2003/documents.shtml>. Accessed September 23, 2003.

Genetic Resources Action International (GRAIN). 2003. Public research: Which public is that? *Seedling,* July 2003. <www.grain.org/publications/seed-03-07-4-en.cfm>. Accessed October 7, 2003.

———. 2001. Apomixis: The plant breeder's dream. *Seedling,* September 2001. <www.grain.org/publications/seed-01-9-2-en.cfm>. Accessed October 7, 2003.

———. 1998. A greener than green revolution? *Seedling,* December 1998. <www.grain.org/publications/dec982-en-p.htm>. Accessed October 7, 2003.

Guilloux, A. and S. Moon. 2001. Hidden price tags: disease-specific drug donations: costs and alternatives. Geneva, Switzerland: Médecins Sans Frontières/Drugs for Neglected Diseases Working Group Paper.

Grupo Papalotla. 2002. Corporate Profile. <http://www.grupopapalotla.com /ingles/interior_profile.htm>. Accessed December 9, 2003.

Hall, A., R. Sulaiman, N. Clark, M.V.K. Sivamohan and B. Yoganand. 2002. Public-private sector interaction in the indian agricultural research system: An innovation systems

perspective on institutional reform. In *Agricultural research policy in an era of privatization,* ed. D. Byerlee and R. Echeverría. Oxon, UK: CABI.

Harinarayana, G. 2001. Public and private sectors: The seed links. In A *sharing perspectives on public-private sector interaction,* ed. .J. Hall, B. Yoganand, V. Rasheed Sulaiman, and N.G. Clark. Proceedings of a Workshop, April 10, Patancheru, India. Patancheru: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

Hartwich, F, W. Janssen and J. Tola. 2003. *Public-private partnerships for agroindustrial research: Recommendations from an expert consultation.* ISNAR Briefing Paper, no. 61. The Hague, The Netherlands: International Service for National Agricultural Research (ISNAR).

HarvestPlus. 2003. HarvestPlus. Breeding Crops for Better Nutrition. <http://www.harvestplus.org>. Accessed December 19, 2003.

Hazell, P.B.R. and L.J. Haddad. 2001. *Agricultural research and poverty reduction.* 2020 Vision Discussion Paper. Washington, D.C.: International Food Policy Research Institute.

Ho, M. 2003. Public/private partnerships too close for comfort? Rice is life series 1. *Science in Society.* <http://www.i-sis.org.uk/RiceIsLife1.php>. Accessed January 5, 2004.

Ho, M. 2002. Science for the poor, or procurer for the rich? Rice is life series 4. *Science in Society* 15: 8. <http://www.i-sis.org.uk/RiceIsLife4.php>. Accessed January 5, 2004.

Huang, J., S. Rozelle, C. Pray, and Q. Wang. 2002. Plant biotechnology in China. *Science 295* (5555): 674–677.

Initiative on Public-private partnerships for health (IPPPH). 2003. <http://www.ippph.org/index.cfm>. Accessed December 5, 2003.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). 2003. *Theme 1: Leader's Note.* <http://www.icrisat.org>. Accessed October 9, 2003.

International Institute of Tropical Agriculture (IITA). 2003. Cassava. <http://www.iita.org/crop/cassava.htm>. Accessed December 10, 2003.

International Rice Research Institute (IRRI). 2003. *Hybrid rice means more rice*. <http://www.irri.org/irrc/hybridrice/index.asp>. Accessed October 6, 2003.

———. 2001. 'Golden Rice' arrives in Asia. Press release, March 23, 2001. <http://www.irri.org/textonly/media%20resources/press%20releases/2001/golden%20rice.htm>. Accessed October 2, 2003.

———. 1996 (revised 1997). Bt Rice: Research and policy issues. *IRRI Information Series* No. 5. Los Baños, Philippines: International Rice Research Institute.

International Service for the Acquisition of Agri-biotech Applications (ISAAA). 2003. ISAAA projects. <http://www.isaaa.org>. Accessed January 8, 2004.

International Service for National Agricultural Research (ISNAR). 2003a. Public-private partnerships for agroindustrial research (PPP). <http://www.isnar.cgiar.org/ppp/index.htm>. Accessed September 23, 2003.

———. 2003b. *Approaching public-private partnerships for agroindustrial research: a methodological framework.* The Hague, the Netherlands: International Service for National Agricultural Research.

James, C.J. 1996. Agricultural research and development: The need for public-private sector partnerships. *Issues in Agriculture* 9. Washington, D.C.: Consultative Group on International Agricultural Research.

Komen, J. 2000. International Initiatives in agri-food biotechnology. In *Biotechnology in the developing world and countries in economic transition,* ed. G.T. Tzotzos and K.G. Skryabin. Wallingford, U.K.: CABI.

Larkin, R.G. 1994. Public-private partnerships in economic development: A review of theory and practice. *Economic Development Review* 12(1) (Winter 1994): 7-9.

Lehman, V. 2001. New models for public-private partnerships in drug development. *Biotechnology and Development Monitor* 46 (June 2001): 2-7.

Leisinger, K.M. 1995. *Sociopolitical effects of new biotechnologies in developing countries.* Food, Agriculture and the Environment, discussion paper no. 2. Washington, D.C.: International Food Policy Research Institute.

Lewis, J. 2000. Leveraging partnerships between the public and the private sector: Experience of USAID's agricultural biotechnology programs. In *Agricultural biotechnology and the poor,* ed. G. J. Persley and M. M. Lantin. Proceedings of an International Conference, October 21-22, 1999, Washington, D.C. Washington, D.C.: Consultative Group on International Agricultural Research.

Michelsen, H. 2003. *Learning from partnerships. Experiences from the Cornell International Institute for Food, Agriculture and Development (CIIFAD).* The Hague: International Service for National Agricultural Research.

Mitchell-Weaver, C. and Manning, B. 1990. Public-private partnership in third world development. 20th Norma Wilkinson Memorial Lecture, May 15, 1990. Reading: Department of Geography, Reading University.

Meinzen-Dick, R. S., A. Adato, L. Haddad and P. Hazell. 2003. *Impacts of agricultural research on poverty: Findings of an integrated economic and social analysis.* EPTD Discussion

Paper 111/FCND Discussion Paper 164. Washington, D.C.: International Food Policy Research Institute.

Monsanto. 2003. Monsanto donates research to help develop provitamin A enhanced maize for Africa. <http://www.monsanto.com/monsanto/layout/ media/03/10-14b-03.asp>. Accessed November 14, 2003.

Nene, V., S. Morzaria, L. Baker, et al. 2000. Genomics research: Prospects for improving livestock productivity. In *Agricultural Biotechnology and the Poor,* ed. G. J. Persley and M. M. Lantin. Proceedings of an International Conference, October 21-22, 1999, Washington, D.C. Washington, D.C.: Consultative Group for International Agricultural Research.

Ollila, E. 2003. Health-related public-private partnerships and the United Nations. In *Global social governance—themes and prospects*, ed. Deacon, B. et al. Helsinki: Globalism and Social Policy Programme.

O'Looney, J. 1992. Public-Private partnerships in economic development: negotiating the trade-off between flexibility and accountability. *Economic Development Review* 10(4) (Fall 1992): 14-22.

Pardey, P. G. and N. M. Beintema. 2001. *Slow magic: Agricultural R&D a century After Mendel.* Technical Report 36, Agricultural Science and Technology Indicators. Washington, D.C.: International Food Policy Research Institute.

Patino, B.O. and R. Best. 2002. Strategic alliances of cassava farmers with private and public sectors: A new approach for development of the cassava crop in Latin America, *9th JIRCAS International Symposium 2002*: 62-68.

Pray, C. E. 2001. Public-private sector linkages in research and development: Biotechnology and the seed industry in Brazil, China and India. *American Journal of Agricultural Economics* 83(3) (August 2001): 742–747.

Pray, C. E., J. Huang, R. Hu, and S. Rozelle. 2002. Five years of Bt cotton in China—the benefits continue. *Plant Journal* 31(4) (April 2002): 423–430.

Private Sector Committee of the Consultative Group on International Agricultural Research (PSC). 2003. Report of the 17th Meeting of the CGIAR Private Sector Committee, January 3-24, 2003, London. Meeting Report. Washington, D.C.: Consultative Group on International Agricultural Research.

———. 1999. Report of the Tenth Meeting of the CGIAR Private Sector Committee, March 11-12, Hattersheim, Germany. Meeting Report. Washington, D.C.: Consultative Group on International Agricultural Research.

Raman, K. 1995. Facilitating plant biotechnology transfer to developing countries. In *Plant biotechnology transfer to developing countries*, ed. D. Altman and K. Watanabe. Austin, TX, USA: R.G. Landes Company.

Rangan, S., R. Samii and L.N. Van Wassenhove. 2003. *Constructive partnerships: When alliances between private firms and public actors can enable creative strategies.* Manuscript, July.

Reddy, V.S., A.J. Hall and K.N. Rai. 2001. The long road to partnership: private support of public research on sorghum and pearl millet. In *Sharing perspectives on public-private sector interaction,* ed. A.J. Hall, B. Yoganand, V. Rasheed Sulaiman, and N.G. Clark. Proceedings of a Workshop, April 10, Patancheru, India. Patancheru: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

Richer, D. L. and E. Simon. 2000. Perspectives from industry: AgrEvo. In *Intellectual property rights in agriculture*, ed. U. Lele, W. Lesser, and G. Horstkotte-Wesseler. Environmentally and Socially Sustainable Development Series, Rural Development. Washington, D.C.: World Bank.

Richter, J. 2003. *'We the people' or 'we the corporations'? Critical reflections on UN-business 'partnerships.'* Geneva: IBFAN-GIFA.

———. 2001. 'Partnerships' between UN agencies and transnational companies: A critical perspective. In *Public-Private 'Partnerships': Addressing Public Health Needs or Corporate Agendas?* Health Action Internationa1 Seminar Report,. Geneva: IBFAN-GIFA.

Roberts, M.J., A.G. Breitenstein and C.S. Roberts. 2000. The ethics of public-private partnerships. Presented at the Workshop on Public-Private Partnerships in Public Health, April 7-8, Endicott House, Dedham, MA.

Rosenau, P.V. 2000. The strengths and weaknesses of public-private policy partnerships. In *Public-Private Policy Partnerships,* ed. P.V. Rosenau. Cambridge, Mass: MIT Press.

Roundtable on Sustainable Palm Oil (RSPO). 2003. Roundtable on sustainable palm oil. <http://www.sustainable-palmoil.org>. Accessed October 7, 2003.

Sandman, P.M, P.M. Miller, B. B. Johnson and N.D. Weinstein. 1993. Agency Communication, Community outrage, and perception of risk: Three simulation experiments. *Risk Analysis* 13(6): 585-598.

Sandman, P.M., N.D. Weinstein, and W.K. Hallman. 1998. Communications to reduce risk underestimation and overestimation. *Risk Decision and Policy* 3(2): 93-108.

Shear, R. H. 2000. Perspectives from industry: Monsanto. In *Intellectual property rights in agriculture*, ed. U. Lele, W. Lesser, and G. Horstkotte-Wesseler. Environmentally and

Socially Sustainable Development Series, Rural Development 3. Washington, D.C.: World Bank.

Syngenta Foundation. 2003. *Insect resistant maize for africa project review report, Nairobi, Kenya, February, 2-14, 2003.* <http://www.syngentafoundation.org/pdf/kenya_irma_project_review_2003.pdf>. Accessed September 30, 2003.

Taylor, M. 2003. 'Super' stress tolerant wheats outcome of new alliance. *Ground Cover* 46 (September 2003). <http://www.grdc.com.au/growers/gc/gc46/ stress_tolerant.htm>. Accessed December 18, 2003.

Taylor, M. and J. Cayford. 2003. *American patent policy, biotechnology, and African agriculture: The case for policy change.* Washington, D.C.: Resources for the Future,

United Nations Foundation and the World Economic Forum (UNF/WEF). 2003. *Public-private partnerships: meeting in the middle.* <http://www.weforum.org/pdf/Initiatives/GHI_2003_Meeting_in_the_middle.pdf>. Accessed September 30, 2003.

Van der Meer. K. 2002. Public-private cooperation in agricultural research: examples from the Netherlands. In *Agricultural research policy in an era of privatization,* ed. D. Byerlee and R. Echeverría Oxon, UK: CABI.

Vieira, L.F., and F. Hartwich. 2002. *Approaching public–private partnerships for agroindustrial research: A methodological framework.* Coronado, Costa Rica: ISNAR Office at IICA.

Walt, G. and L. Lush. 2001. Getting drugs to where they are needed: global public private partnerships for neglected diseases. *Biotechnology and Development Monitor* 46 (June 2001): 9-12.

Webber, D. and M. Kremer. 2001. Perspectives on stimulating industrial research and development for neglected infectious diseases. *Bulletin of the World Health Organization* 79(8): 735-741.

Williamson, O.E. 1979. Transaction-cost economics: The governance of contractual relations. *Journal of Law and Economics* 22: 233-61.

———. 1975. *Markets and hierarchies*. London: Free Press, Collier Macmillan.

World Bank. 2003. *The CGIAR at 31: An independent meta-evaluation of the consultative group on international agricultural research,* vol. 3. Operations Evaluation Department. Washington, D.C.: World Bank.

———. 2002. *The World Bank's Approach to Global Programs: An Independent Evaluation, Phase I Report.* Operations Evaluation Department. Washington, D.C.: World Bank.

World Economic Forum (WEF). 2003a. Successful public-private partnership. From the World Economic Forum Annual Meeting 2003, January 24, 2003. <http://www.weforum.org>. Accessed September 29, 2003.

———. 2003b. African food security: A role for public private partnership. From the World Economic Forum Africa Economic Summit 2003, June 12, 2003. <http://www.weforum.org>. Accessed September 29, 2003.

———. 2003c. Public-private partnerships: From slogan to sustainable delivery. From the World Economic Forum Africa Economic Summit 2003, June 12, 2003. <http://www.weforum.org>. Accessed September 29, 2003

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